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The effect of mobile games on math learning of third graders of elementary schools

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***Abstract*— The purpose of this study is to investigate the effect of mobile games on the learning of mathematics lessons of third grade elementary students. The statistical sample includes two classes of 20 students from the third graders of elementary school in a public school in Tehran, with a total of 40 sample. To measure the changes, a researcher-made questionnaire in the form of pre-test and post-test was used. An independent-samples t-test was conducted to compare post control group and post digital group conditions. There was a significant difference in the scores for control (M=7.15, SD=0.875) and digital (M=8.10, SD=1.252) conditions; t (38) =3.085, p = 0.008. These results suggest that playing mobile games have an effect on math learning. Specifically, our results suggest that playing digital games (mobile games) increases math learning in students of third-grade. Analysis of variance indicates that the effect of playing games is significant on learning mathematics. Comparing the experimental group that played mobile games with the control group that didn't play these games shows that the groups are significantly different and it can be said that learning through games in mathematics is higher than Teaching in the usual ways. The results of the tests show that games have a direct effect on learning mathematics. Also, this form of digital play gives students a lot of trial and error space. Due to the world current circumstances school education has shifted to e-learning and distance learning, and almost all students use computer workspace through tablets, mobile phones, and computers while learning. Mobile games can be one of the teaching aids for teachers to be able to provide their classroom exercises or even their own training based on it. Since this research also confirms the increase in learning through digital games, this can be one of the traceable necessities in the educational system.**

Keywords*— *math learning, mobile games, digital games, elementary school

I. INTRODUCTION

The starting point of the history of the game is not known, but since the time of Plato, philosophers have considered the game as a factor in the development of children. However, for about 300 years, extensive research has been done in the field of games and its importance has been realized [1]. Playing involves both teaching and learning, and the child acquires various skills through play. For this reason, play is the most important tool through which various educational concepts and purposes can be learned [2] [3].

The most important activity and in fact the occupation of children is play, which doubles the attention to play, especially at the ages of growth and learning [4]. The use of existing and emerging tools in education has become so widespread among educators and educational institutions that some see play in education as interference in learning. But its role in education is to increase students 'motivation and participation to improve visual skills, improve students' interaction and cooperation with peers and use them to apply the values of the game in the real world [5]. Research has shown that in preschool centers, children spend lots of time playing unplanned and structured games, while these free games can be targeted for education [6][7].

The method of education in elementary schools, taking into account the spirit of the students, is to use more and more games and entertainment. Therefore, a large part of the activities should be done in the form of games. These games should be included in the lesson objectives so that learning can be done in the best way. The use of educational games to teach or train a variety of topics is very common today, but its effect on learning or motivation has not been well or definitively determined [8]. Therefore, playing games can become educational support and as a way to motivate children to learn. As a tool for learning, these games are a source of great interest for teachers, because their importance is directly related to human development from a social, creative, emotional, historical, and cultural perspective [3].

Educational games can be used to activate students and foster creativity in them. In educational games where situations are defined interactively between teaching and learning, two or more students try to achieve the desired goals. Games, in addition to having to have connections

between their various parts; should also lead to strengthening accuracy and concentration [9]. Math games and hobbies promote mental development, initiative, imagination and analytical thinking, concentration, and willpower to deal with the growing problems of social and professional life, leading students to become more aware of the importance of this topic. Take it and understand it better. Math-centered hobbies lead students to both loves and use math throughout their lives [10].

Today, researches have shown that students learn better when learning is active. One of the active learning methods is to use games. Playing is not only a means of entertainment, it is also instructive and constructive. During playing games, especially educational games, children gain access to new mental concepts and acquire more skills [11]. Mathematics, which is always a challenge for students, has been able to encourage students to learn mathematics by combining learning and entertainment by using educational games. When a student plays different games, he or she automatically practices different skills to master math. Teaching in the form of children's favorite games is one of the best ways to consolidate and accelerate math learning (same source). Thus, since the use of games is effective in learning, the researcher tries to test this assumption: **Playing mobile games affect math learning.** For this purpose, the mobile version of two well-known commercial games called "Splendor" and "Ticket to Ride" was used to test this assumption.

II. METHODS

The statistical population used in this study are male students in the third grade of the elementary schools in Tehran. These students were selected based on available sampling, but students were placed in groups by random assignment. The tools of this research were researcher-made pre-test and post-test including questions in mathematics that were administered to all sample students. These tests were researcher-made and the questions were the same for both control and experimental groups. These questions were designed from the third-grade math textbook. An attempt was made to cover the designed questions with the main content and concepts used in mathematics in the third grade of elementary school. These tests were presented before and after students were confronted with two mobile games, "Splendor" and "Ticket to Ride".

The experimental group is referred to as (Digital Group) in this research Group. Our digital group was first confronted with the pre-test about math lessons of third-grade elementary schools. After two weeks this group played the two selected mobile games (Ticket to ride & Splendor) then again after two more weeks their math skills were tested with the post-test exam including 12 questions about topics that cover the third-grade math book. The control group didn't play any games between the exams.

A. Ticket To Ride mobile game

This game is an adventurous train journey in which players try to win the race by taking advantage of the different train lines that connect the cities on the game screen. At the beginning of the game, different cards are handed to the players and the players have to constantly decide during the game which cards to hold in their hands and which to discard. The goal of the game is to get the most points. In this game, players calculate their points according to the type of path they have built and the length of that path. The mechanism for estimating scores is also based on basic mathematical principles.

B. Splendor mobile games

In this game, players play the role of wealthy merchants of the Renaissance and must use the initial resources at their disposal to acquire valuable mines and use artisans and artists to cut raw gemstones and Turn them into precious jewelry. Different stones have different values and players must calculate the values of these stones before acting.

In both of this mobile games basic mathematical principles such as Addition, subtraction, multiplication and division are being taught to children through the gameplay.

III. THE IMPORTANCE OF PLAING GAMES

Playing game is the most important activity of children that promotes their social, emotional, physical, and learning development. Playing is actually a job for children. "Play is a profession for children and allows them to freely experience the world around them and the world of their inner feelings," [4] professor of psychology at the University of California, Berkeley. Researches emphasizes that there are differences between what children learn in school as math and what they actually face [7] [12]. Mathematics is learned in the real life of children, in real conditions, and in order to achieve a specific goal, and children understand the mathematics that they think is meaningful and objective [12].

Other research has shown that children have different needs and these needs can be met with the help of games. One of these needs is the child's innate need to think and reason. On the one hand, this ability is shown to the child through play, and on the other hand, play can make the child think. Considering only the cognitive and intellectual dimension in human beings is an incomplete and one-dimensional view, so sufficient attention should be paid to this part of the human existential need, which is much more prominent in childhood. Because one of the basic needs of a child is his emotions and feelings and attention to it. The child is very much influenced by the environment, so by enriching the environment, conditions are provided for the child to be able to learn and this need is met in a suitable environment. As a result, play and toys have an important role in this matter, and by enriching the play environment, the child can be affected in the best way [13].

If the game is accompanied by a pleasant result and the lesson activity is linked to the game, the child will be interested in the lesson. Playing in the child involves creating pleasure, value creation, and motivation. Students show great interest in the game; Because they are in the process of activity [14]. Games and culture are interactively and closely related, and recent research has shown that the social context of games can change the effects of game content. The culture of playing a game of any gender has a direct impact on the audience's perception of the content of the game [15].

Games have a culture of cooperation and regardless of the type of game, whether it is educational or from another genre, it is the culture of cooperation in the game that makes up the game experience. In educational games, students also interact and collaborate, whether in the form of competition or partnership [16].

IV. GAMES AND LEARNING

Play is a learning and educational activity that is accompanied by joy and pleasure. Exploration and learning are central to the game. The unlimited learning that is achieved in the game leads to social, personal, and psychological development, as well as the acquisition of skills and awareness. Play is known as the great road of learning, especially in the early years of childhood. The game complements formal school curricula by providing opportunities for learning and acquisition. Games teach children different physical and social skills as well as attitudes. All these skills facilitate the child's learning in the classroom [17]. Using play as educational material to create a relaxed environment that enables meaningful learning through observation, creativity, logical thinking, problem-solving, expression with different knowledge, and interaction with classmates. It is important to note that not all games fall into the category of educational materials. The element that separates an educational game from a fun game is that educational games or toys are produced with the explicit goal of stimulating meaningful learning [3]. Socially, especially at a young age, the child also experiences social development through the games he or she plays [17]. The important thing is that children play happily. "Every skill should be taught to a child at a certain age, but play can be done at any age, so play is the most educational activity for children," says Syvenky, a child play, and learning expert. The child learns many things while playing that may be hidden from your view. Even when children get tired of one game and turn to another, it does not mean that the game is not suitable and this issue does not hurt learning [17].

V. DIGITAL AND MOBILE GAMES

Digital games are a popular form of entertainment and media use, which can also provide learning opportunities. Digital games are designed for gaming with a computer, video game console, mobile phone, and interactive TV. Digital games must be accessible through an electronic interface such as a mobile phone or computer. In fact, digital games are electronic environments that can be controlled or manipulated by a human user for entertainment purposes [18]. Carl Gross believes that the game consists of a series of exercises aimed at preparing for the future. This theory, which makes play an instinct and a form of behavior that should be used in the future, is known as the theory of "exercises and skills" [19].

According to [20] digital gaming is an experimental and interactive media in which participation and collaboration take place in a new world. Although this artificial world is a simulated world, certain types of experiences, such as the design experience, occur in it. Game literacy can be defined as the growing expertise in designing valuable experiences for the game world (especially in semiotic and regular game systems) [21]. argue that when people are playing, they do so as those whose identities are in the context of the culture in which they are formed and that culture has shaped their desires and abilities. Players enter the game both as creators and as players and can create a different reading in their minds. In digital games we can no longer consider media consumers as viewers, even if we use the term "active viewer", the act of watching can no longer describe what consumers do with new media [22].

VI. RESULTS

In order to test our assumption, we have compared the data from control group and digital group then independent-samples t-test and effect size were conducted. Results can be seen in Table I, Table II and Table III.

TABLE I

	t	***df***	***sig***	***Mean Difference***	***Std. Error Difference***
Control group and digital group	3.085	38	0.008	1.333	0.357

TABLE II

	N	***Minimum***	***Maximum***	***Mean***	***Std. Deviation***
	Statistic	***Statistic***	***Statistic***	***Statistic***	***Statistic***
Pre digital score	20	1	3	2.05	0.567
Pre control score	20	1	3	1.89	0.484
Post digital score	20	6	11	8.10	1.252
Post control score	20	6	9	7.15	0.875

TABLE III

Source	*Type III Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*	*Partial Eta Squared*
Corrected Model	3.002a	5	0.600	0.728	0.614	0.206
Intercept	581.173	1	581.173	704.598	0.000	0.981
Post digital	3.002	5	0.600	0.728	0.614	0.206
Error	11.548	14	0.825			
Total	1037.000	20	0.600			
Corrected Total	14.550	19				

An independent-samples t-test was conducted to compare post control group and post digital group conditions. There was a significant difference in the scores for control (M=7.15, SD=0.875) and digital (M=8.10, SD=1.252) conditions; t (38)=3.085, p = 0.008. These results suggest that playing mobile games have an effect on math learning. Specifically, our results suggest that playing digital games (mobile games) increases math learning in students of third-grade. It also can be concluded from the results that playing games that don't directly teach math skills are effective on students' performance on math tests.

As Cohen suggested that d = 0.2 is considered a 'small' effect size, 0.5 represents a 'medium' effect size and 0.8 a 'large' effect size. This means that if two groups' means don't differ by 0.2 standard deviations or more, the difference is trivial, even if it is statistically significant. Therefore, as can be seen in Table III, playing mobile games have large effect on third graders math learning.

VII. CONCLUSION

Examination of the hypothesis of this study showed that playing digital games has an effect on the learning of third-grade elementary students and has increased their math learning rate. Findings obtained in this study are in line with the findings of [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34].

Since playing game is always part of the learning process, it seems that purposeful games in elementary school can increase the learning rate of students and soften the anxious atmosphere of symbolic teaching and mathematical rules. Also, the use of games will affect other developmental dimensions and will strengthen other dimensions, including cognitive, emotional, and social development. Playing these games digitally also boosts the spirit of collaboration, and research has shown that even if the games are competitive, players work together to create a gaming experience and go through the process [15] [35]. Also, the play space gives students a lot of trial and error space. These tests and errors are without fear and anxiety of the result and evaluation, which seems to be a good space to create a learning challenge. Due to the world current circumstances (Covid-19) school education has shifted to e-learning and distance learning, and almost all students learn to work with digital workspace through tablets, mobile phones, and computers while learning. Digital games can be one of the teaching aids for teachers to be able to provide their classroom exercises or even their own training based on it. The results have also shown that playing mobile games can make the students cooperate to keep the game flow and as a result, they learn to cooperate while solving math problems. The traditional teaching methods isolate students and don't promote teamwork values or interacting with others. This could lead to a lack of social skills for students which is increased by social distancing and mandatory E-learning.
Since this research also confirms the increase in learning through digital games, this can be one of the traceable necessities in the educational system.

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